MIC79110

Simple 1.2A Linear Li-ion Battery Charger

Features

- Input Voltage Range: 2.5V to 16V
- High Output Voltage Accuracy of ±0.75% over –5˚C to +60˚C
- Current Limit ±5% Accurate from –5°C ≤ T_J ≤ +125°C
- Programmable End-of-Charge Flag
- Analog Output Proportional to Output Current
- Adjustable and Fixed 4.2V Output
- Low Dropout Voltage of 550 mV at 700 mA Load, over Temperature
- 1.2A Maximum Charge Current
- Excellent Line and Load Regulation Specifications
- Reverse-Current Protection
- Thermal Shutdown and Current-Limit Protection
- Tiny 10-Lead 3 mm x 3 mm VDFN Package
- Junction Temperature Range: –40°C to +125°C

Applications

- Cellular Phones and PDAs
- Digital Cameras and Camcorders
- MP3 Players
- Notebook PCs
- Portable Meters
- Cradle/Car Chargers and Battery Packs

General Description

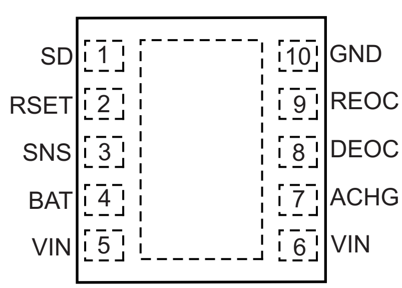
The MIC79110 is a simple and accurate lithium-ion battery charger. The part features a built-in pass transistor, precision programmable current limiting (±5%), and precision voltage termination (±0.75% over temperature). The MIC79110 packs full functionality into a small space.

Other features of the MIC79110 include two independent indicators: a digital end-of-charge signal that is programmable with a resistor-to-ground and an analog current output that is proportional to the output current, allowing for monitoring of the actual charging current. Additional features include very low dropout (550 mV over the temperature range), thermal shutdown, and reverse polarity protection. In the event the input voltage to the charger is disconnected, the MIC79110 also provides minimal reverse-current and reversed-battery protection.

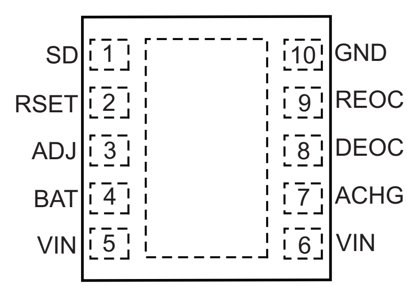
Available in both fixed 4.2V and adjustable outputs, the MIC79110 is offered in the leadless 10-pin 3 mm x 3 mm VDFN with an operating junction temperature range of –40˚C to +125˚C.

Package Types

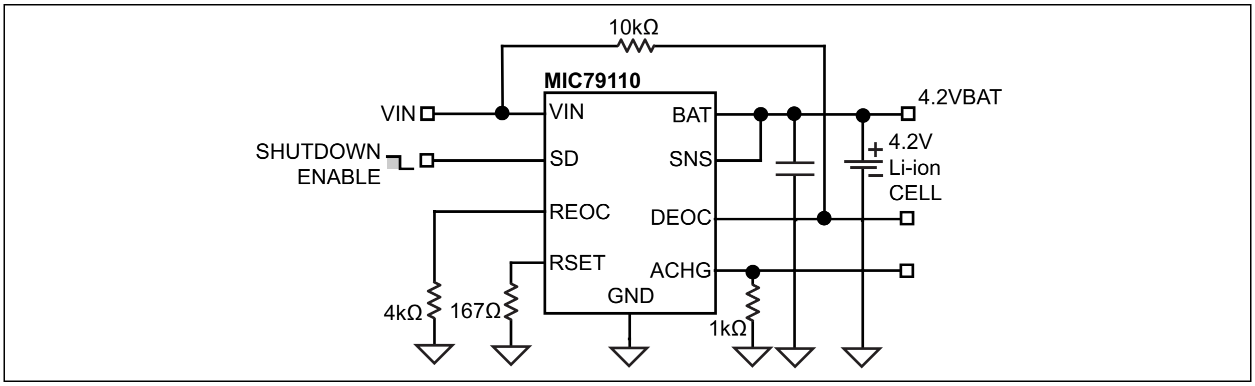
MIC79110
10-Lead VDFN (ML)
(Top View, Fixed Version)



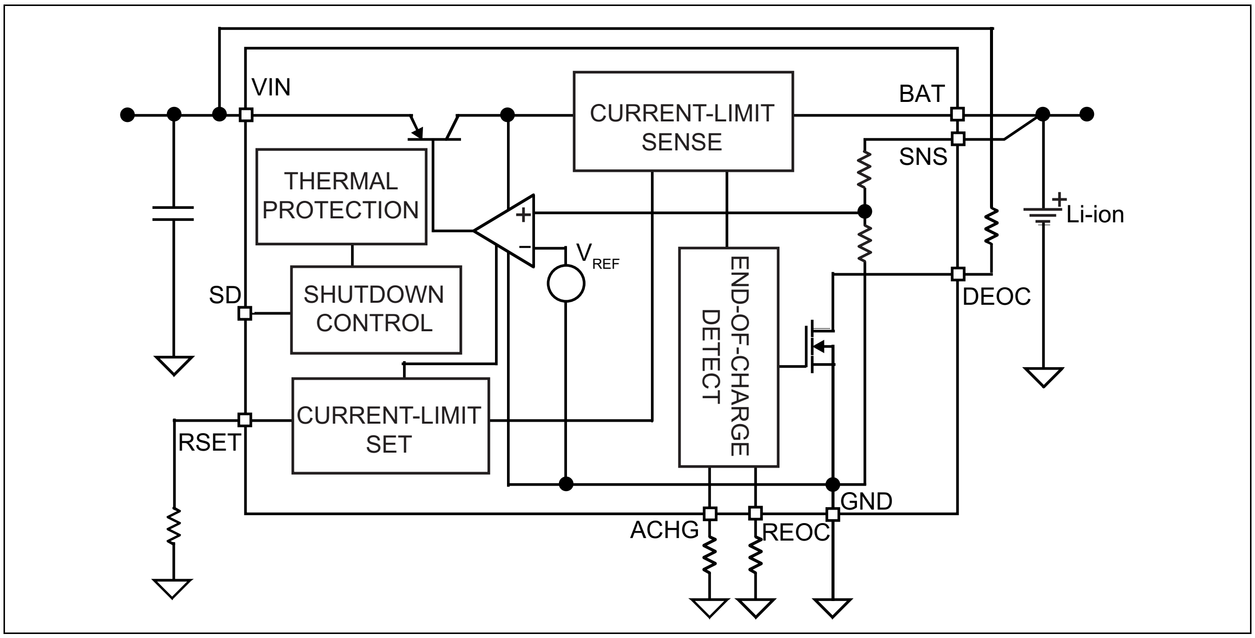
MIC79110
10-Lead VDFN (ML)
(Top View, Adjustable Version)



Typical Application Circuit



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Supply Voltage (V_{IN}) .... 0V to +18V
Shutdown Input Voltage (V_{SD}) .... 0V to +10V
Output Voltage (ADJ) .... +10V
Power Dissipation .... Internally Limited

Operating Ratings ‡

Input Supply Voltage .... +2.5V to +16V
Shutdown Input Voltage (V_{SD}) .... 0V to +7V
Output Voltage (ADJ) .... +9.6V

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ Notice: The device is not guaranteed to function outside its operating ratings.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: T_A = +25°C with V_{IN} = V_{OUT} + 1V; I_{LOAD} = 100 µA; C_{BAT} = 10 µF; SD = 0V; R_{SET} = 1 kΩ. **Bold** values valid for –40ºC < T_J < +125°C; unless otherwise specified. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy	V_O	–0.75	—	0.75	%	V_{OUT} = 4.2V; I_{LOAD} = 50 mA; T_J = –5°C to +60°C
		–1.5	—	**1.5**		V_{OUT} = 4.2V; I_{LOAD} = 50 mA; T_J = –40°C to +125°C
ADJ Pin Voltage Accuracy	—	0.5955	0.6	0.6045	V	—
Line Regulation	$\Delta V_{OUT}/(V_{OUT} \times \Delta V_{IN})$	–0.1	—	0.1	%/V	V_{IN} = V_{OUT} + 1V to 16V @ I_{LOAD} = 50 mA
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	—	0.3	—	%	I_{LOAD} = 0.1 mA to 1A
Dropout Voltage, Note 2	V_{DO}	—	160	**250**	mV	I_{LOAD} = 100 mA, R_{SET} = 167Ω
		—	375	**550**		I_{LOAD} = 700 mA, R_{SET} = 167Ω
Ground Current	I_{GND}	—	2	3	mA	I_{LOAD} = 10 mA, R_{SET} = 167Ω
		—	24	**35**		I_{LOAD} = 700 mA, R_{SET} = 167Ω
VIN Pin Current	I_{VIN}	—	120	**300**	µA	SD = V_{IN}
Shutdown Pin Current	I_{SD}	—	0.1	**5**	µA	SD = 5.2V, V_{BAT} = 0V
Shutdown Input Threshold	V_{SD_TH}	**1.05**	—	—	V	Logic High, regulator off
		—	—	**0.93**		Logic Low, regulator on
Shutdown Hysteresis	V_{SD_HYS}	—	60	—	mV	—
Current Limit Accuracy (Note 3, Note 4)	—	**–5**	—	**5**	%	V_{OUT} = 0.9 x V_{NOM}; I_{OUT} = 1.2A, R_{SET} = 167Ω, T_J = –40°C to +85°C
		–20	—	**20**		V_{OUT} = 0.9 x V_{NOM}; I_{OUT} = 0.1A, R_{SET} = 2 kΩ
Current Limit Setpoint Range	I_{CHRG_RNG}	0.1	—	1.2	A	Note 4
Maximum Current Limit	$I_{LIM(MAX)}$	1.25	1.65	**2.5**	A	R_{SET} shorted to ground, V_{BAT} = 0.9 x V_{NOM}
V_{BAT} Reverse Current	I_{BAT_REV}	—	4.2	**20**	µA	V_{IN} = High impedance or ground

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: T_A = +25°C with V_{IN} = V_{OUT} + 1V; I_{LOAD} = 100 µA; C_{BAT} = 10 µF; SD = 0V; R_{SET} = 1 kΩ. **Bold** values valid for –40ºC < T_J < +125°C; unless otherwise specified. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Digital End-of-Charge (DEOC) Output						
End of Charge Current (Note 5, Note 6)	I_{EOC}	35	50	65	mA	R_{EOC} = 4 kΩ, Current Falling
		30	50	**70**		
		50	70	95	mA	R_{EOC} = 4 kΩ, Current Rising
		40	70	**100**		
Digital End of Charge Logic Low Voltage	D_{EOC_LOW}	—	0.74	**0.95**	V	I_{EOC} = 5 mA, I_{BAT} = 700 mA
Digital End of Charge Leakage Current	D_{EOC_LK}	—	0.1	—	µA	Logic HIGH = V_{IN} = 16V
Digital End of Charge On Resistance	$D_{EOC\_RDS(ON)}$	—	150	190	Ω	V_{IN} = +5V
R_{EOC} Maximum Current Limit		**0.5**	1.0	**2.0**	mA	R_{EOC} shorted to ground
Analog Charge Indicator (ACHG) Output						
Source Current, Note 7	I_{SOURCE}	**37**	46	**55**	µA	I_{BAT} = 50 mA
		800	950	**1150**		I_{BAT} = 1.2A, T_J = –40°C to +85°C

Note 1: Specification for packaged product only.

2: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at 1V differential. For outputs below 2.5V, dropout voltage is the input-to-output voltage differential with the minimum input voltage 2.5V. Minimum input operating voltage is 2.5V.

3: V_{NOM} denotes the nominal output voltage.

4: I_{RSET} = (0.2V/R_{SET}) x 1000.

5: Output current I_{EOC} when digital end-of-charge output goes high impedance. Currents greater than I_{EOC}, the DEOC output is low, currents lower than I_{EOC}, DEOC is high impedance.

6: I_{EOC} = (0.2V/R_{EOC}) × 1000.

7: I_{SOURCE} is the current output from ACHG pin. A resistor to ground from the ACHG pin will program a voltage that is proportional to the output current.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Junction Temperature Range	T_J	–40	—	+125	°C	—
Package Thermal Resistances						
Thermal Resistance, VDFN 10-Ld	θ_{JA}	—	60	—	°C/W	—
	θ_{JC}	—	2	—	°C/W	—

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

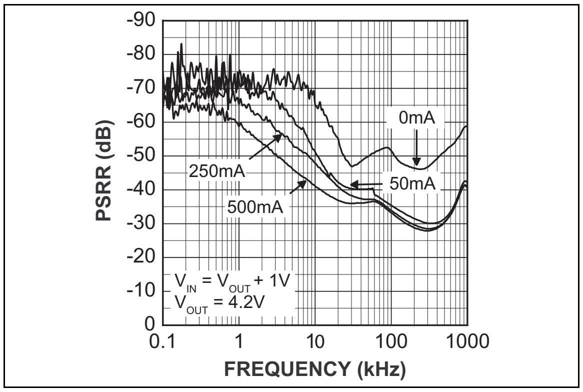


FIGURE 2-1: *PSRR.*

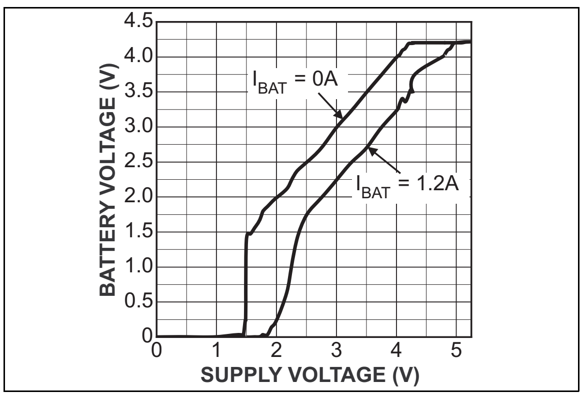


FIGURE 2-2: *Dropout Characteristics.*

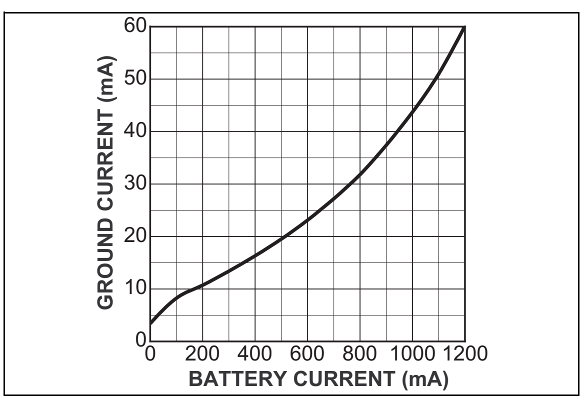


FIGURE 2-3: *Battery Current vs. Ground Current.*

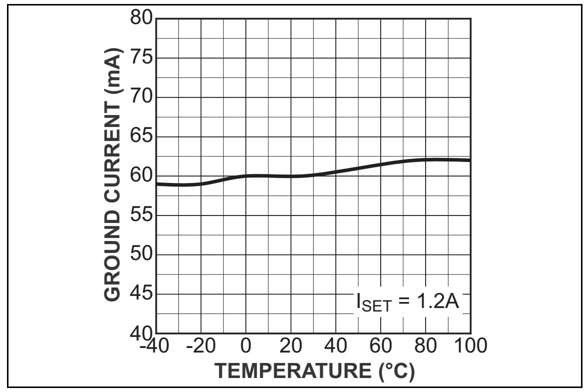


FIGURE 2-4: *Ground Current vs. Temperature.*

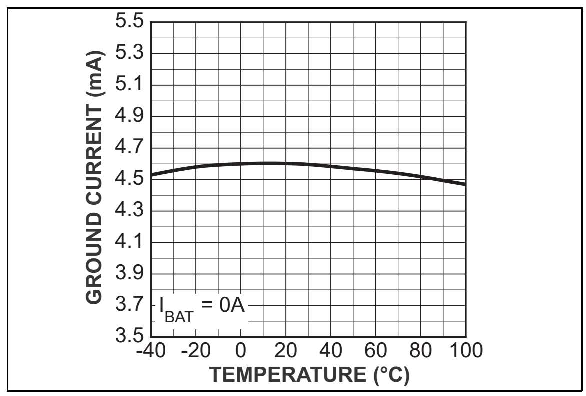


FIGURE 2-5: *Ground Current vs. Temperature.*

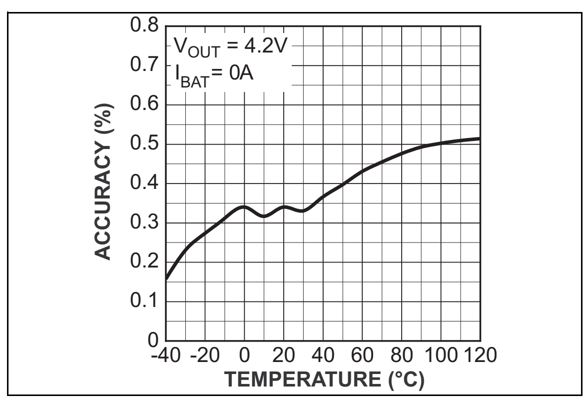


FIGURE 2-6: *Battery Voltage vs. Temperature.*

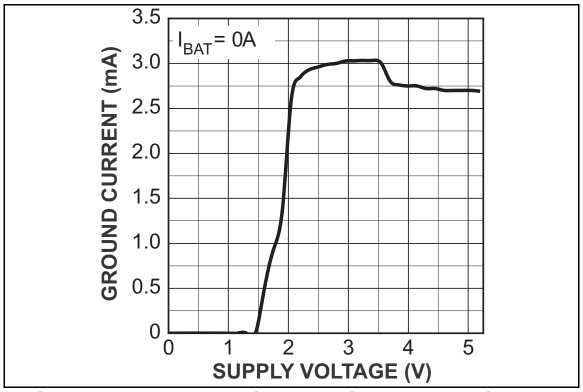


FIGURE 2-7: Ground Current vs. Supply Voltage.

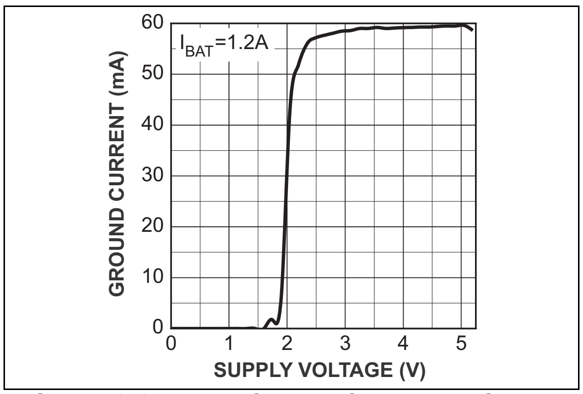


FIGURE 2-8: Ground Current vs. Supply Voltage.

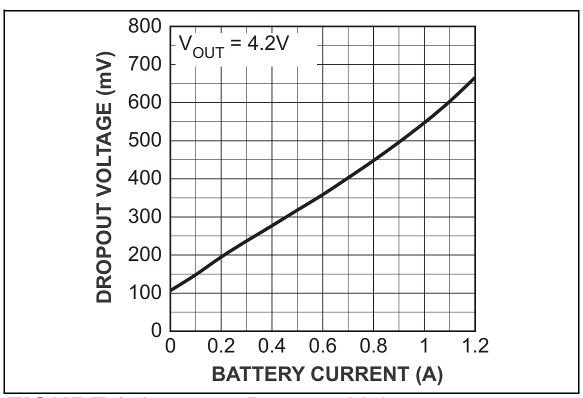


FIGURE 2-9: Dropout Voltage.

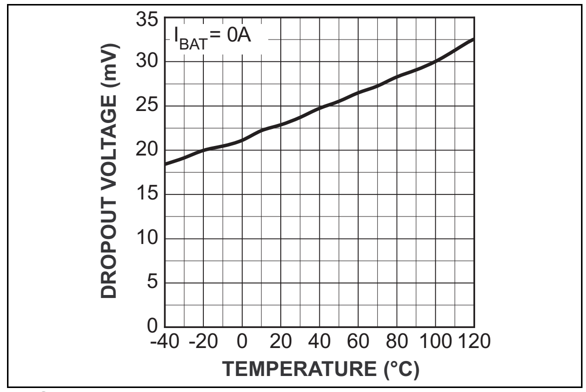


FIGURE 2-10: Dropout Voltage vs. Temperature.

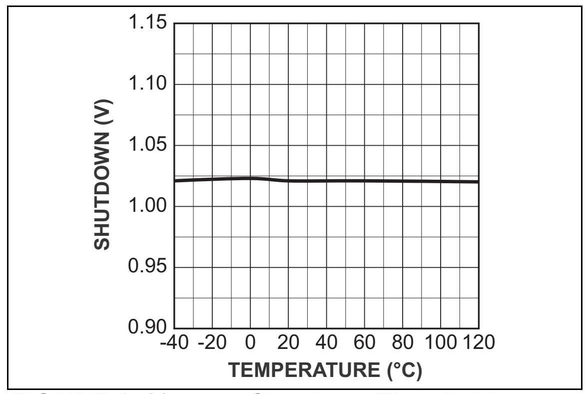


FIGURE 2-11: Shutdown Threshold vs. Temperature.

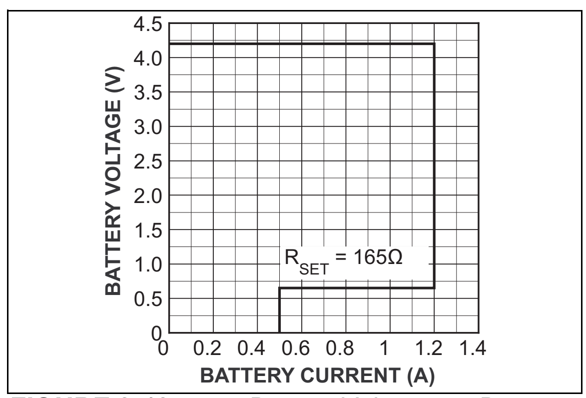


FIGURE 2-12: Battery Voltage vs. Battery Current.

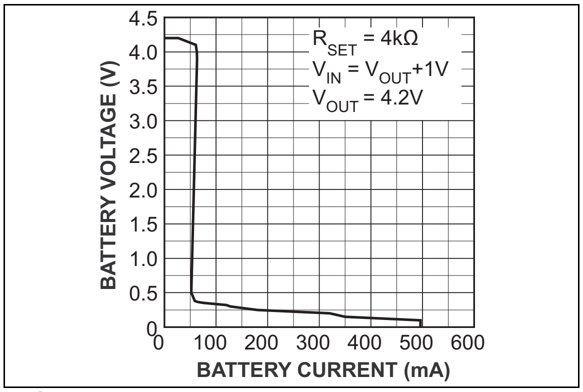


FIGURE 2-13: *Battery Voltage vs Battery Current.*

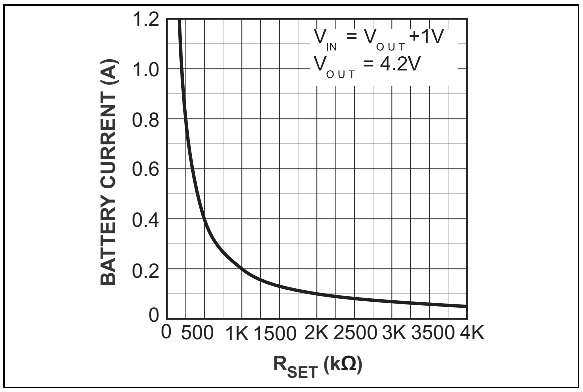


FIGURE 2-14: *Battery Current vs. R_{SET}.*

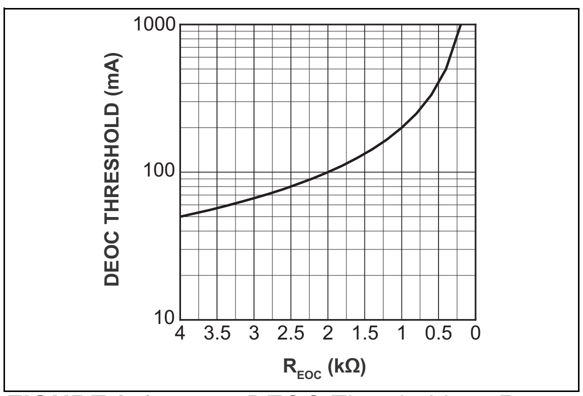


FIGURE 2-15: *DEOC Threshold vs. R_{EOC}.*

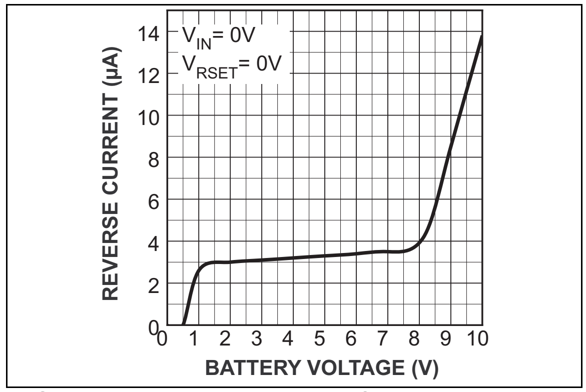


FIGURE 2-16: *Reverse Current vs. Battery Voltage.*

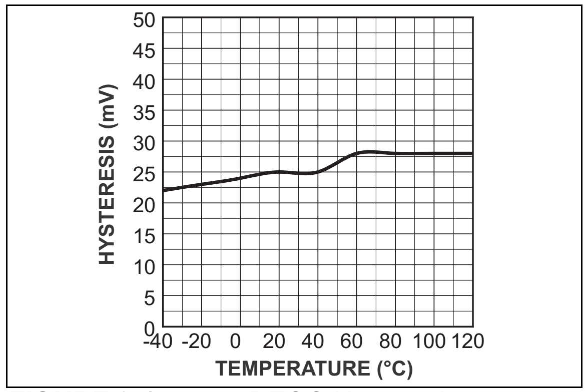


FIGURE 2-17: *DEOC Hysteresis.*

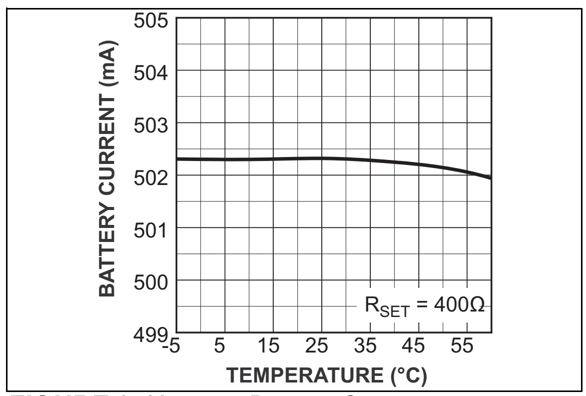


FIGURE 2-18: *Battery Current vs. Temperature.*

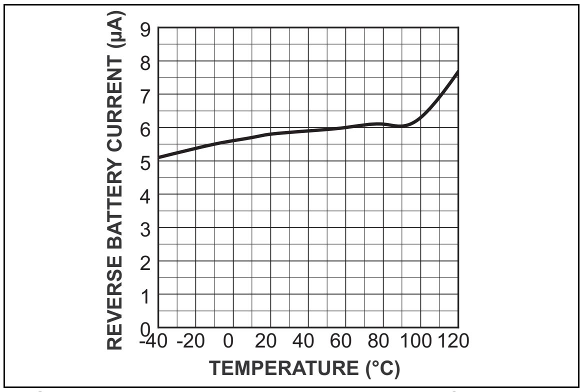


FIGURE 2-19: *Reverse Battery Current vs. Temperature.*

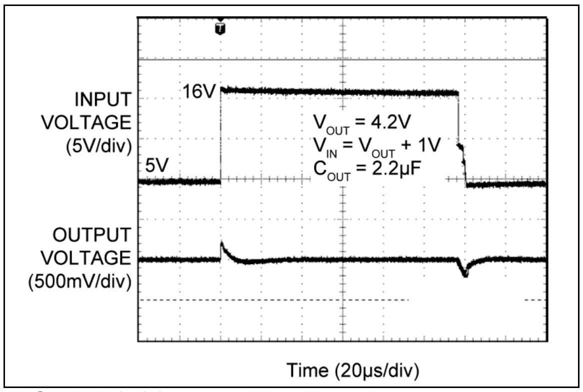


FIGURE 2-20: *Line Transient.*

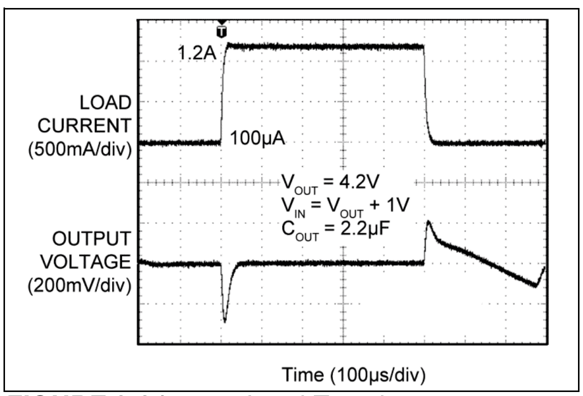


FIGURE 2-21: *Load Transient.*

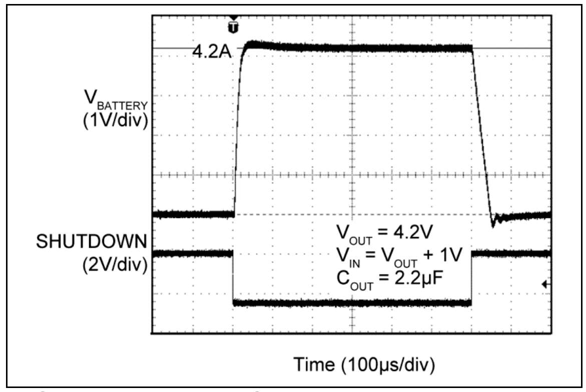


FIGURE 2-22: *Shutdown Transient.*

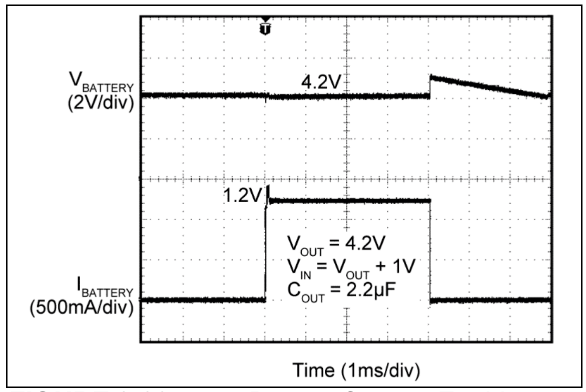


FIGURE 2-23: *Battery Current Enable Transient.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	SD	Shutdown Input. Logic HIGH = Off; Logic LOW = On.
2	RSET	Current limit: Sets constant current limit via an external resistor to ground. I_{RSET} = (0.2V/R_{SET}) x 1000.
3	SNS	(Fixed voltage only): Sense output: connect directly to battery.
	ADJ	(Adjustable voltage only): Feedback input.
4	BAT	Battery Terminal. Connect to single-cell lithium-ion battery.
5, 6	VIN	Input supply pins.
7	ACHG	Analog Charge Indicator Output: Current source whose output current is equal to 1/1000 of the BAT pin current.
8	DEOC	Digital End-of-Charge Output: N-Channel open-drain output. LOW indicates charging, a current that is higher than the programmed current set by R_{EOC} is charging the battery. When the current drops to less than the current set by R_{EOC}, the output goes high impedance, indicating end-of-charge.
9	REOC	End-of-Charge Set: Sets end-of-charge current threshold via an external resistor to ground. I_{EOC} = (0.2V/R_{EOC}) x 1000.
10	GND	Ground.

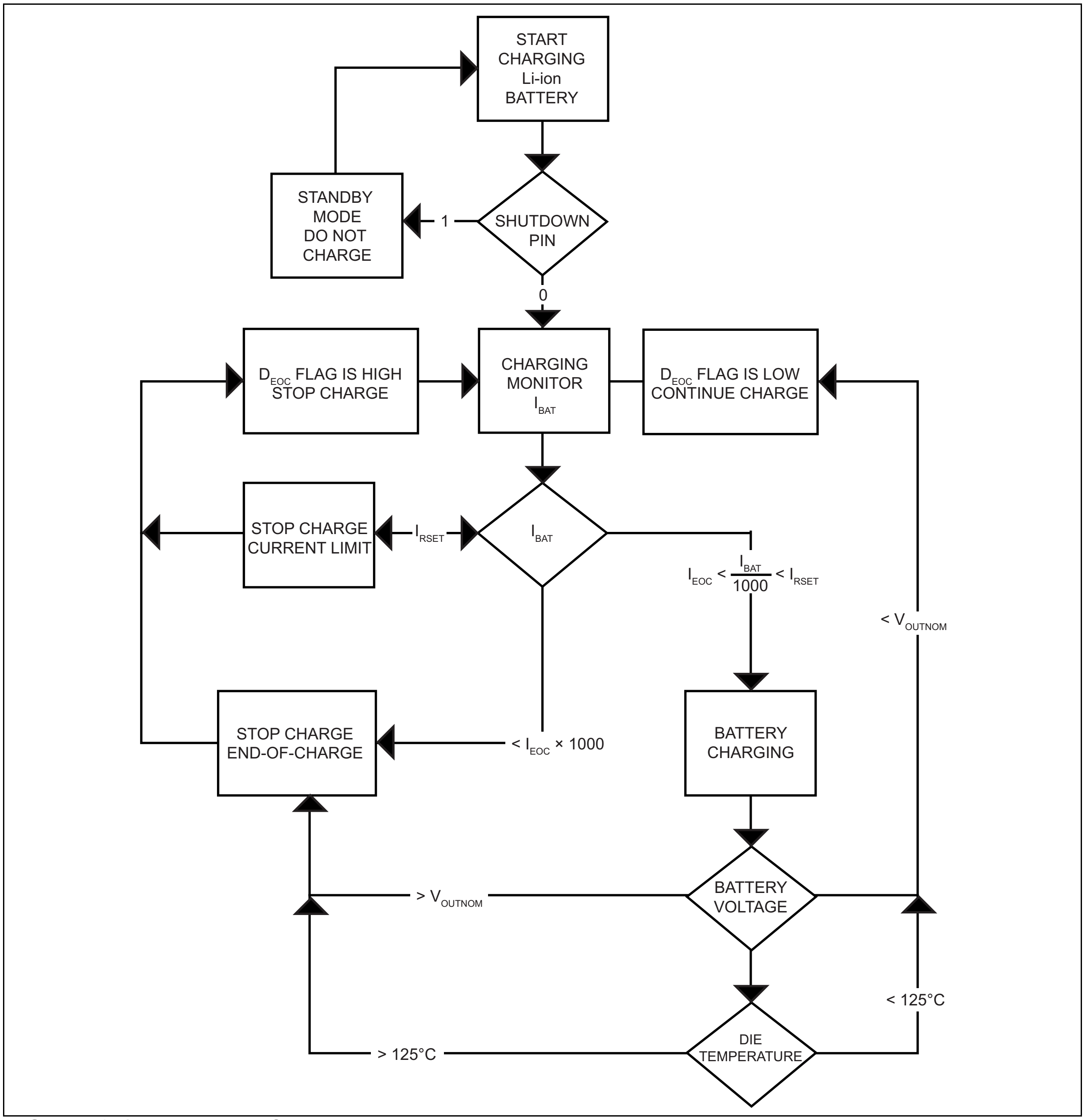


FIGURE 3-1: *Flow Chart.*

4.0 APPLICATION INFORMATION

4.1 Detailed Description

The MIC79110 forms a complete charger for 1-cell lithium-ion batteries. It includes precision voltage control (0.75% over temperature) to optimize both cell performance and cycle life. All are compatible with common 4.2V lithium-ion chemistries. Voltages other than 4.2V can be obtained with the adjustable version. Other features include current limit, end-of-charge flag, and end-of-charge current limit using an external resistor. The shutdown pin enables low quiescent current when not charging.

4.2 Current Limit Mode

MIC79110 features an internal current limit that is set by the RSET pin with a resistor-to-ground. The maximum current is calculated by Equation 4-1:

EQUATION 4-1:

$$I_{RSET} = (0.2V/R_{SET}) \times 1000$$

Using a 167Ω RSET resistor will achieve the maximum current limit for the MIC79110 at 1.2 amperes.

4.3 End-of-Charge

The R_{EOC} pin is connected to a resistor-to-ground. This resistor is used to set the end of charge current for the lithium-ion battery as in Equation 4-2:

EQUATION 4-2:

$$I_{EOC} = (0.2V/R_{EOC}) \times 1000$$

Using a 4 kΩ R_{EOC} resistor will set the end-of-charge current at 50 mA.

I_{EOC} should be set at 10% of the battery's rated current.

4.4 Digital End-of-Charge Output

This pin is the output of an open drain. When tied high to the supply using a resistor, the output will toggle high or low depending on the output current of I_{BAT}.

- Low state indicates that the I_{BAT} current is higher than the programmed current set by R_{EOC}.
- High state indicates that the I_{BAT} current is lower than the programmed current set by R_{EOC}. The output goes high impedance indicating end-of-charge.

4.5 Analog End-of-Charge Output

The ACHG pin provides a small current that is proportional to the charge current. The ratio is set at 1/1000th of the output current.

4.6 Shutdown

The SD pin serves as a logic input (active low) to enable the charger.

Built-in hysteresis for the shutdown pin is 50 mV over temperature.

4.7 Reverse Polarity Protection

In the event that $V_{BAT} > V_{IN}$ and the shutdown pin is active low, there is reverse battery current protection built in. The current is limited to less than 10 µA over temperature.

4.8 Constant Output Voltage/Current Charging

The MIC79110 features constant voltage and constant current output to correctly charge lithium-ion batteries. The constant voltage is either 4.2V or adjustable. The constant current is set by the R_{SET} pin and is constant down to around 300 mV. Because R_{SET} can be set below 500 mA, the minimum output current is set at 500 mA for output voltages below 100 mV. This minimum voltage starts the charging process in lithium-ion batteries. If the output current is too low, the battery will not begin charge.

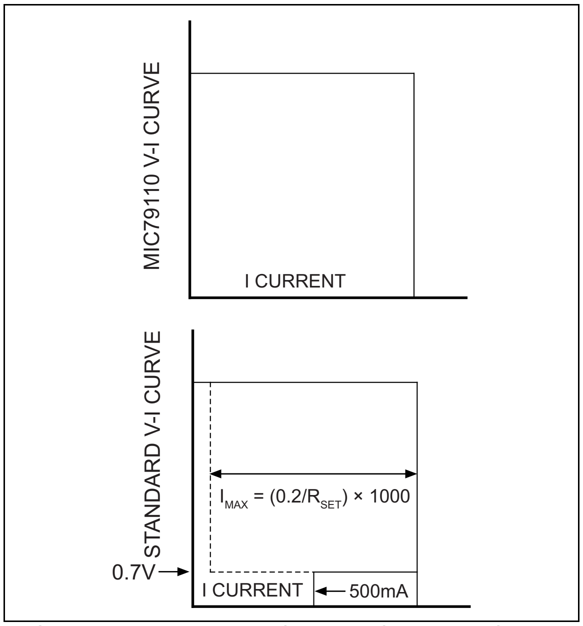


FIGURE 4-1: *MIC79110 Constant Output Voltage.*

4.9 Lithium-ion Batteries

Lithium-ion batteries are charged in two stages to reach full capacity. The first stage charges the battery with maximum charge current until 90% of the battery cell's voltage limit is reached. The second stage tops off the charge with constant voltage charge as the charge current slowly decreases. End of charge is reached when the current is less than 3% of the rated current. A third stage will occasionally top off with charge with constant voltage charge if the battery voltage drops below a certain threshold.

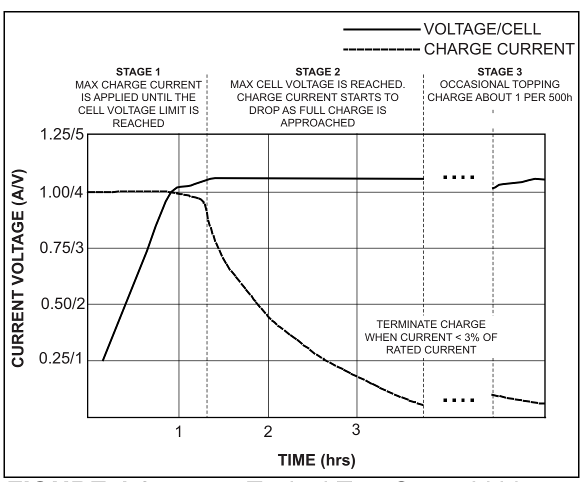


FIGURE 4-2: *Typical Two-Stage Lithium Charge Profile.*

All lithium-ion batteries take approximately 3 hours to charge with the second stage taking twice as long as the first stage. Some chargers claim to be fast chargers by skipping the second stage and just charges the battery until the cell voltage is reached. This only charges the battery to 70% capacity.

An increase in the charge current during Stage 1 does not shorten the total charge time. It will only shorten the time for Stage 1 to complete and lengthen the time in Stage 2.

The lithium-ion loses charge due to aging whether it is used or not. Do not store the batteries at full charge and high heat because it will accelerate the aging process. Try and store with 40% charge and in a cool environment.

4.10 Lithium-ion Safety Precautions

Every lithium-ion battery pack should have a safety circuit which monitors the charge and discharge of the pack and prevents dangerous occurrences.

The specifications of these safety circuits are dictated by the cell manufacturer and may include the following:

- Reverse polarity protection.
- Charge temperature must not be charged when temperature is lower than 0°C or above 45°C.
- Charge current must not be too high, typically below 0.7°C.
- Discharge current protection to prevent damage due to short circuits.
- Protection circuitry for over voltage applied to the battery terminals.
- Overcharge protection circuitry to stop charge when the voltage per cell rises above 4.3V.
- Over discharge protection circuitry to stop discharge when the battery voltage falls below 2.3V (varies with manufacturer).
- Thermal shutdown protection for the battery if the ambient temperature is above 100°C.

4.11 Auto Top-Off Charger Application Circuit

Lithium-ion batteries will begin to lose their charge over time. The MIC79110 can be configured to automatically recharge the battery when the voltage drops below the minimum battery voltage. This minimum voltage is set by a resistor divider at the battery and is connected to the SD pin. For instance, if V_{BAT} is 4.2V and the battery voltage falls to 3.72V, SD pin gets divided down by R1 and R2 to 0.93V and starts the normal charging process. While charging, the DEOC indicator is turned on, pulling the SD pin to GND, keeping the MIC79110 on. When the end of charge is reached, the DEOC pin opens. The divided down BAT voltage is now 1.05V at the SD pin, ending the charging process.

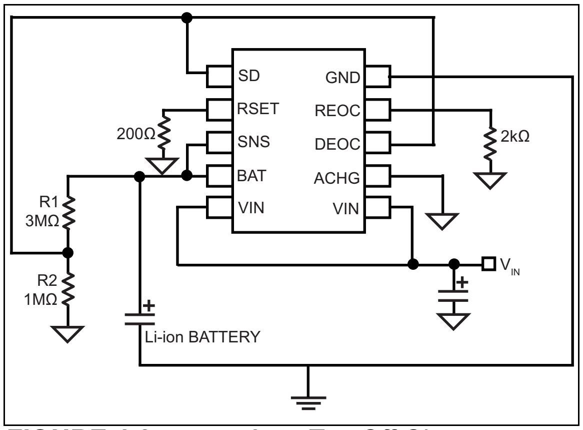


FIGURE 4-3: Auto Top-Off Charger Application Circuit.

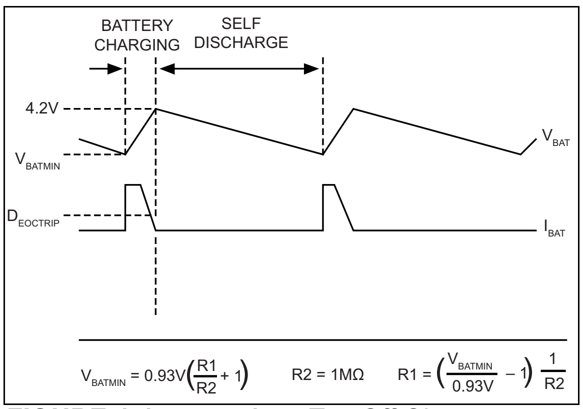


FIGURE 4-4: Auto Top-Off Charger Application.

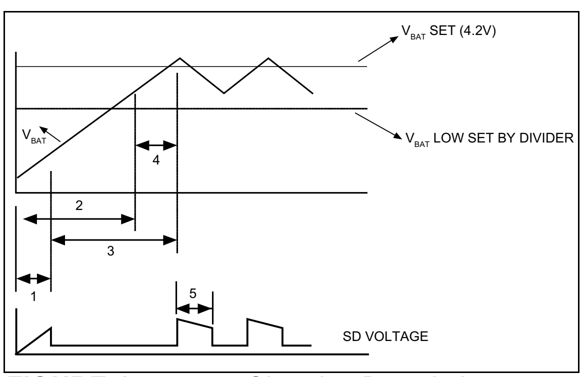


FIGURE 4-5: Charging Description.

1. SD not held low by active high DEOC because DEOC comparator's inputs do not common-mode to ground. Divider holds SD low so part can start.
2. SD held low by divider.
3. SD held low by active high DEOC.
4. Divider voltage above SD threshold and DEOC open.
5. Divider voltage drops below SD threshold and charging begins again.

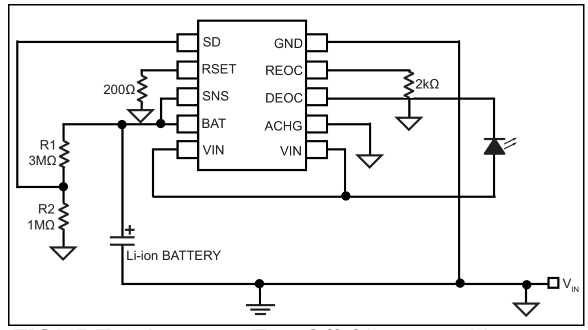


FIGURE 4-6: Top-Off Charger with Internal Reset Application Circuit.

This circuit is similar to the auto top-off charger circuit mentioned above except that the DEOC pin is externally triggered to restart the charging cycle. It still uses the same resistor divider to set the minimum battery voltage before the lithium-ion needs to be recharged.

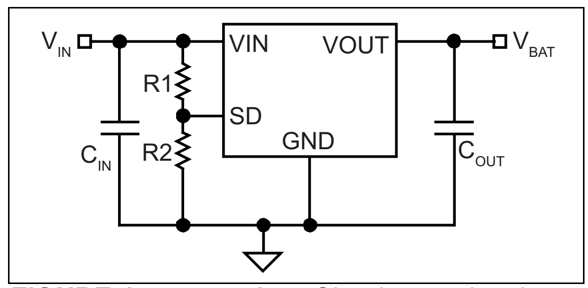


FIGURE 4-7: Auto-Shutdown using the Shutdown Pin.

The shutdown pin on the MIC79110 can be used to automatically shutdown the battery charger when the input voltage rises above a safe operating voltage. To keep the part from heating up and entering thermal shutdown, we can connect the shutdown pin to VIN using a resistor divider. Use Equation 4-3 to setup the maximum V_{IN}:

EQUATION 4-3:

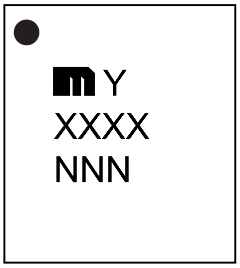
$$\frac{V_{IN(MAX)}}{V_{SD}} = \frac{R1}{R2} + 1$$

The MIC79110 can be connected to a wall wart with a rectified DC voltage and protected from over voltages at the input.

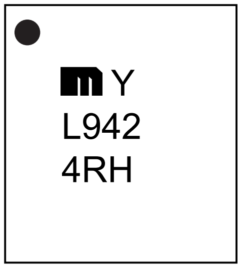
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

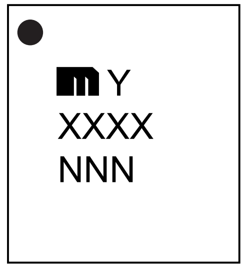
10-Lead VDFN* (Fixed)



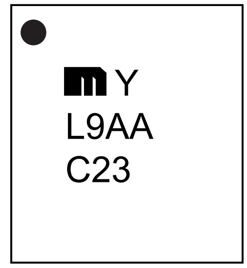
Example



10-Lead VDFN* (Adjustable)



Example



Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).

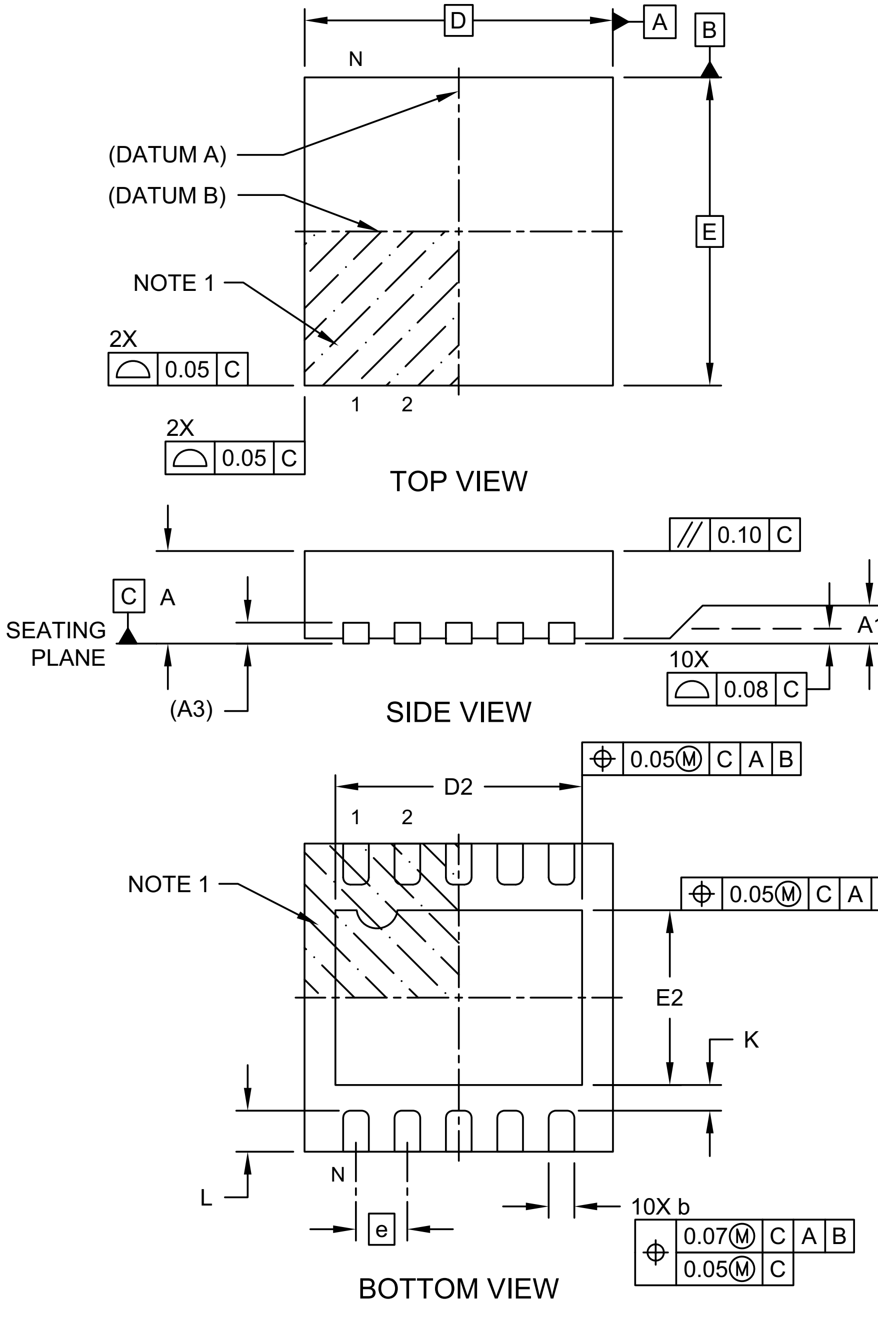
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar (_) symbol may not be to scale.

Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
6 Characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
2 Characters = NN; 1 Character = N

10-Lead Very Thin Plastic Dual Flat, No Lead Package (JFA) - 3x3x0.9 mm Body [VDFN]
Micrel Legacy Package DFN33-10LD-PL-1

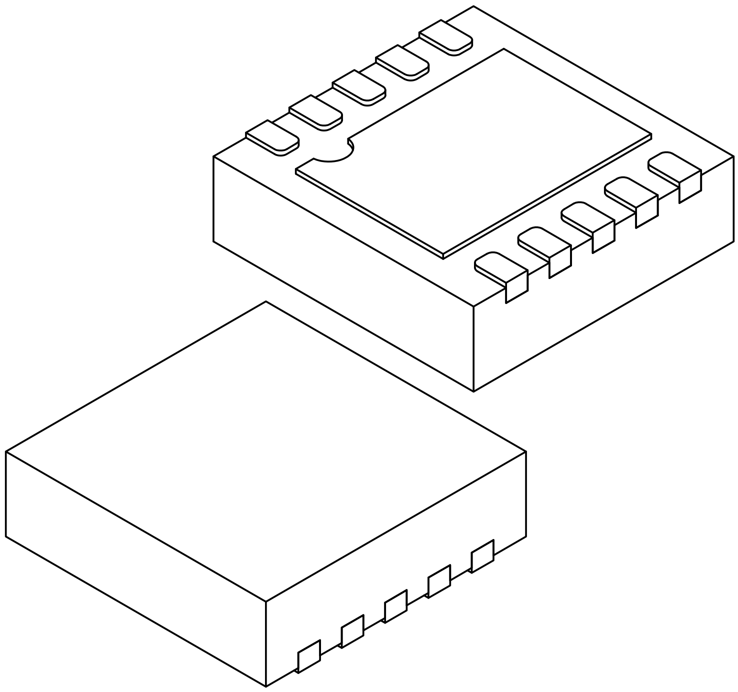
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-1019-JFA Rev A Sheet 1 of 2

10-Lead Very Thin Plastic Dual Flat, No Lead Package (JFA) - 3x3x0.9 mm Body [VDFN]
Micrel Legacy Package DFN33-10LD-PL-1

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		10	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3		0.203 REF	
Overall Length	D		3.00 BSC	
Exposed Pad Length	D2	2.35	2.40	2.45
Overall Width	E		3.00 BSC	
Exposed Pad Width	E2	1.65	1.70	1.75
Terminal Width	b	0.20	0.25	0.30
Terminal Length	L	0.35	0.40	0.45
Terminal-to-Exposed-Pad	K	0.20	–	–

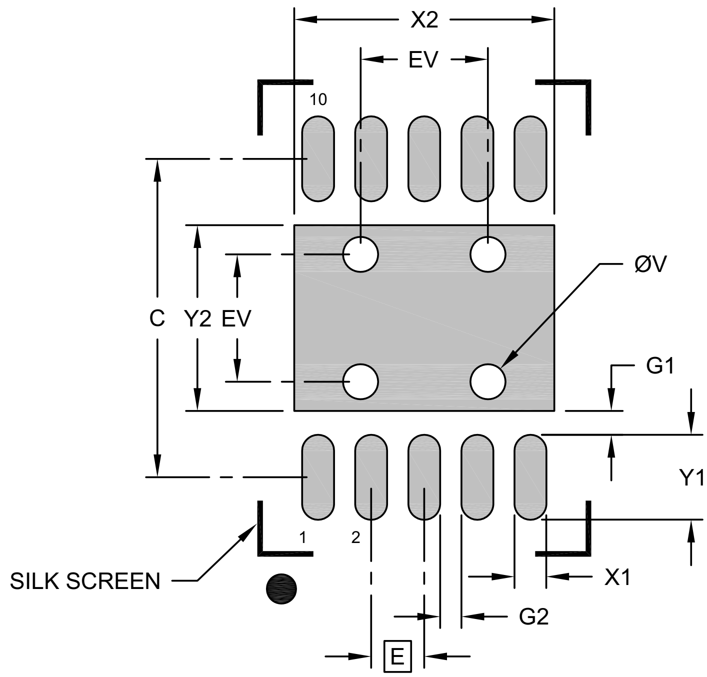
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1019-JFA Rev A Sheet 2 of 2

10-Lead Very Thin Plastic Dual Flat, No Lead Package (JFA) - 3x3x0.9 mm Body [VDFN] Micrel Legacy Package DFN33-10LD-PL-1

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

	Units	MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Contact Pitch	E		0.50 BSC	
Optional Center Pad Width	X2			2.45
Optional Center Pad Length	Y2			1.75
Contact Pad Spacing	C		3.00	
Contact Pad Width (Xnn)	X1			0.30
Contact Pad Length (Xnn)	Y1			0.80
Contact Pad to Center Pad (Xnn)	G1	0.23		
Contact Pad to Contact Pad (Xnn)	G2	0.20		
Thermal Via Diameter	V		0.33	
Thermal Via Pitch	EV		1.20	

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3019-JFA Rev A

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (August 2022)

- Converted Micrel document MIC79110 to Microchip data sheet DS20006715A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

Part Number	[-X.X]	X	XX	-XX
Device	Output Voltage	Temp. Range	Package	Media Type

Device:	MIC79110:	Simple 1.2A Linear Li-ion Battery Charger
Output Voltage:	<blank> =	Adjustable
	4.2 =	4.2V
Temperature Range:	Y =	–40°C to +125°C
Package:	ML =	10-Lead 3 mm x 3 mm VDFN
Media Type:	TR =	5,000/Reel

Examples:

a) MIC79110YML-TR: MIC79110, Adjustable Output Voltage, –40°C to +125°C Temp. Range, 10-Lead VDFN, 5,000/Reel

b) MIC79110-4.2YML-TR: MIC79110, 4.2V Output Voltage, –40°C to +125°C Temp. Range, 10-Lead VDFN, 5,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

ISBN: 978-1-6683-1083-0

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880- 3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820

09/14/21